

NOVEMBER 2019



**WIM #45
CSAH 14, MP
10.1
BLAINE, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #45 is located on CSAH 14 near Blaine in Anoka county.

System Operation

WIM #45 was operational for the entire month of November 2019. Volume was computed using all monthly data.

System Calibration

WIM #45 was most recently calibrated on 2016-01-19. Table 1 summarizes the front axle weights of class 9s by lane ¹. Figure 1 shows the distribution of gross vehicle weights (GVW) in Class 9 vehicles at this site for the last 12 months of operation ². Figure 2 depicts the average front axle weight as a percent difference from the first full month following calibration.

Summary of Volume Statistics

Total Monthly Volume: 407686 | Passenger Vehicles: 396342 | Heavy Commercial Vehicles: 11344

Monthly Average Daily Traffic (MADT): 13603 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 378

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. EB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Sundays. WB vehicles typically reached highest volume levels on Tuesdays, with lowest volumes reported on Sundays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), EB PVs generally reached peak volume levels between 07 AM and 05 PM. Similarly, WB PVs peaked in volume between 03 PM and 05 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling EB typically reached peak volume levels between 07 AM and 05 PM, while volume going WB peaked between 03 PM and 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 5's and Class 6's.

Overweight HCVs

Volume trends. Of a total of 11344 HCVs, 765 of them were overweight ³. These overweight HCVs contributed to 0.2% of total monthly volume, and 6.8% of total monthly

HCV volume. EB overweight vehicles typically reached highest numbers on Thursdays, with lowest volumes reported on Sundays. WB overweight vehicles tended to reach highest volumes on Tuesdays, with lowest volumes reported on Sundays. See Figure 3 .

The top two overweight violators by class were the class 6 and class 9 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 51.6% of all overweight vehicles traveling EB this month (see Figure 7 & 8). Figure 9 shows the number of vehicles exceeding 88,000 pounds that crossed the WIM over the last 12 months. The highest number of 88,000+ vehicles within the last 12 months occurred in June.

WIMs are currently used as a screening tool for weight enforcement, and it is estimated that the WIM scales can measure gross vehicle weights (GVW) within 90-95% of static weight scale measurements. Due to the possibility of measurement error, vehicles exceeding 10% of their legal weight limits (or 1.1 times their legal weight limits) are considered overweight in this report ⁴.

Using normal load limits ,35 EB vehicles exceeded 88,000 pounds (17 vehicles were Class 10's; 14 vehicles were Class 9's). Of vehicles traveling WB,

39 EB vehicles exceeded 88,000 pounds (24 vehicles were Class 10's; 9 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from November 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in November 2019. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling EB, while there were more fully_loaded Class 9's than empty traveling WB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the EB direction. In the WB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 67852 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (53.7%) than WB (46.3%). See Table 4 and Figure 11 for more freight information.

####Infrastructure Considerations Bridge. Bridge No. 02051 (a prestressed concrete beam span) is approximately 2.8 miles west of WIM #45 on CSAH 14, and Bridge No. 02006 (a prestressed concrete beam span) is approximately 5.2 miles east of WIM #45 on CSAH 14. WIM #45 recorded a total of 407686 vehicles with a combined GVW of 2074037 kips (1 kip = 1,000 pounds = 0.5 tons) in November 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 5424 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 53.9% of all ESALs were recorded EB while 46.1% was observed WB. In particular, 32% of all ESALs were generated by the Class 5's (Class 5's were also responsible for generating 6% of total GVW observed this month). See Table 6 and Figures 14-15 for more information on ESALs (Table 6 also provides flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5).

#####WIM monthly reports can be found at:

<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle classification scheme and vehicle class groupings for traffic forecasting can be found at: <http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of ±9% of baseline calibration values
- ² Previous WIM research indicates that unloaded Class 9s typically weigh 28-32 kips, while loaded Class 9s generally fall in the 70-80 kip range. More recent data from several WIM sites suggests that the unloaded Class 9 range may have moved a little higher over time (due to increased presence of sleeper cabs, etc.), although these ranges are also thought to be site-specific.
- ³ An HCV is considered overweight during normal load limits in this report if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 80,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 20,000 pounds; tandem axles spaced 8' or less = 34,000 pounds; tridem axles spaced 9' or less = 43,000 pounds; quad axles spaced 13' or less = 51,000 pounds). Monthly reports use this standard regardless of the time of year however, the Winter Load Increase (WLI) allows a 10% across the board increase in axle and gross vehicle weights without a permit on US, state routes, and county roads. An HCV is considered overweight during Winter Load Increase(WLI) if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 88,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 22,000 pounds; tandem axles spaced 8' or less = 37,400 pounds; tridem axles spaced 9' or less = 47,300 pounds; quad axles spaced 13' or less = 56,100 pounds). An overweight HCV is only included once in the overweight volume calculations regardless of how many of the aforementioned conditions are violated. For information on MN weight limit dates and statutes: http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp
- ⁴ For example, Class 9s and 10s can legally have gross vehicle weights up to 80,000 lbs (with the exception of permitted loads) during normal load limits. To account for measurement error on the WIM scales, those exceeding 10% of the legal GVW maximum (or 1.1 times the legal GVW) should be screened (e.g., 80,000 lbs + 8,000 lbs = 88,000 lbs). Similarly during WLI vehicles weighing 96,800 lbs should be screened.

To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

Figure 1 - Monthly Class 9 GVW Histogram

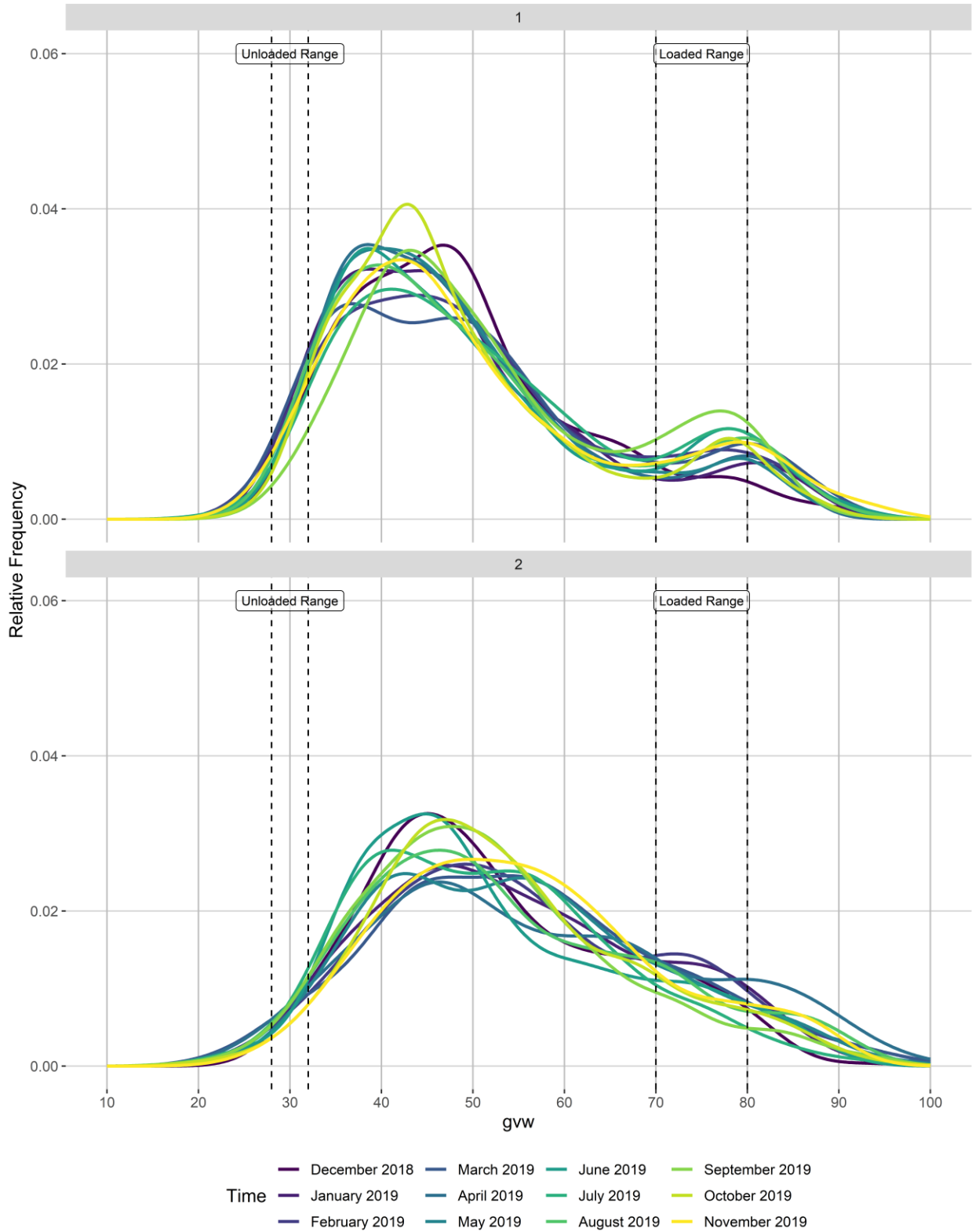
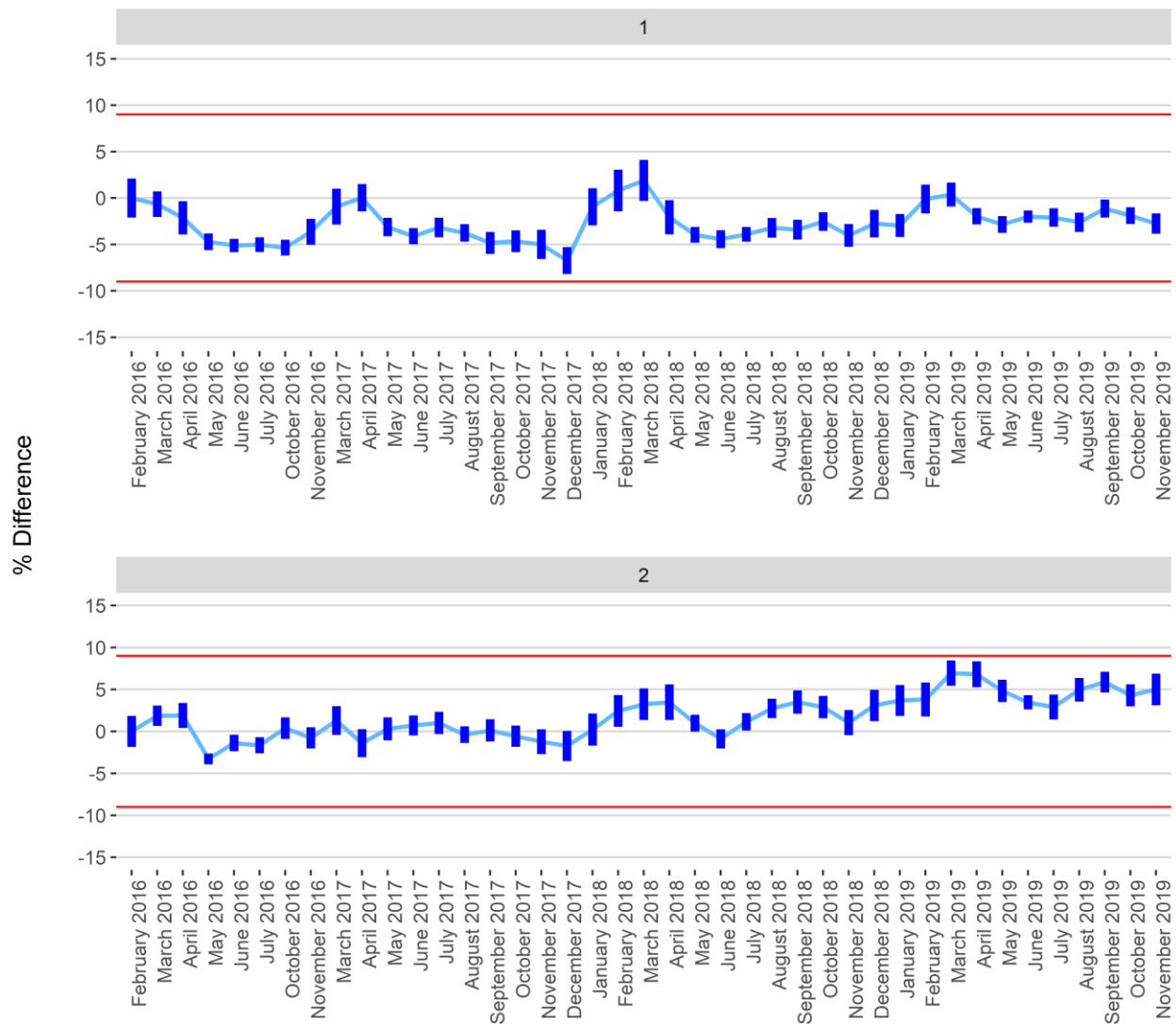


Figure 2 - Percent Difference of Front Axle Weight from
Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume
vs. Day of the Week

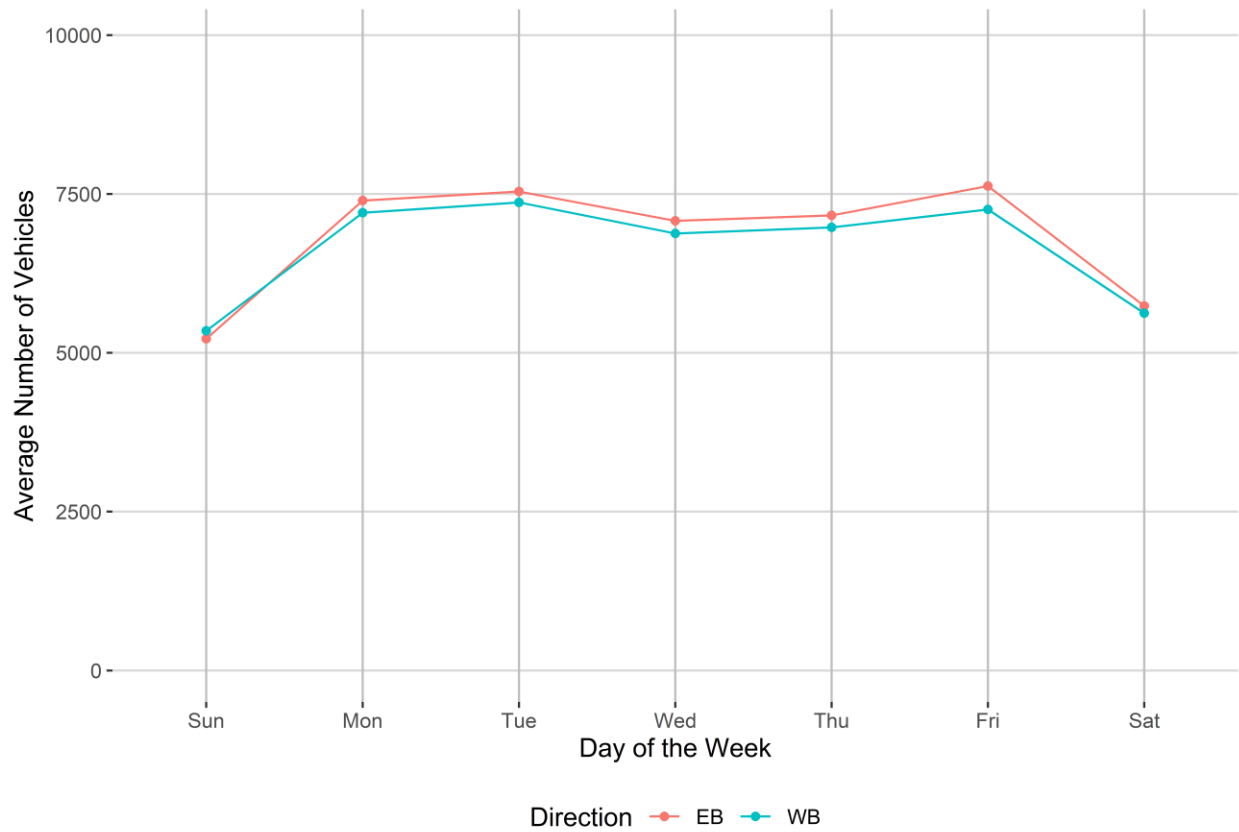


Figure 3 - Average Overweight Vehicle Volume
vs. Day of the Week

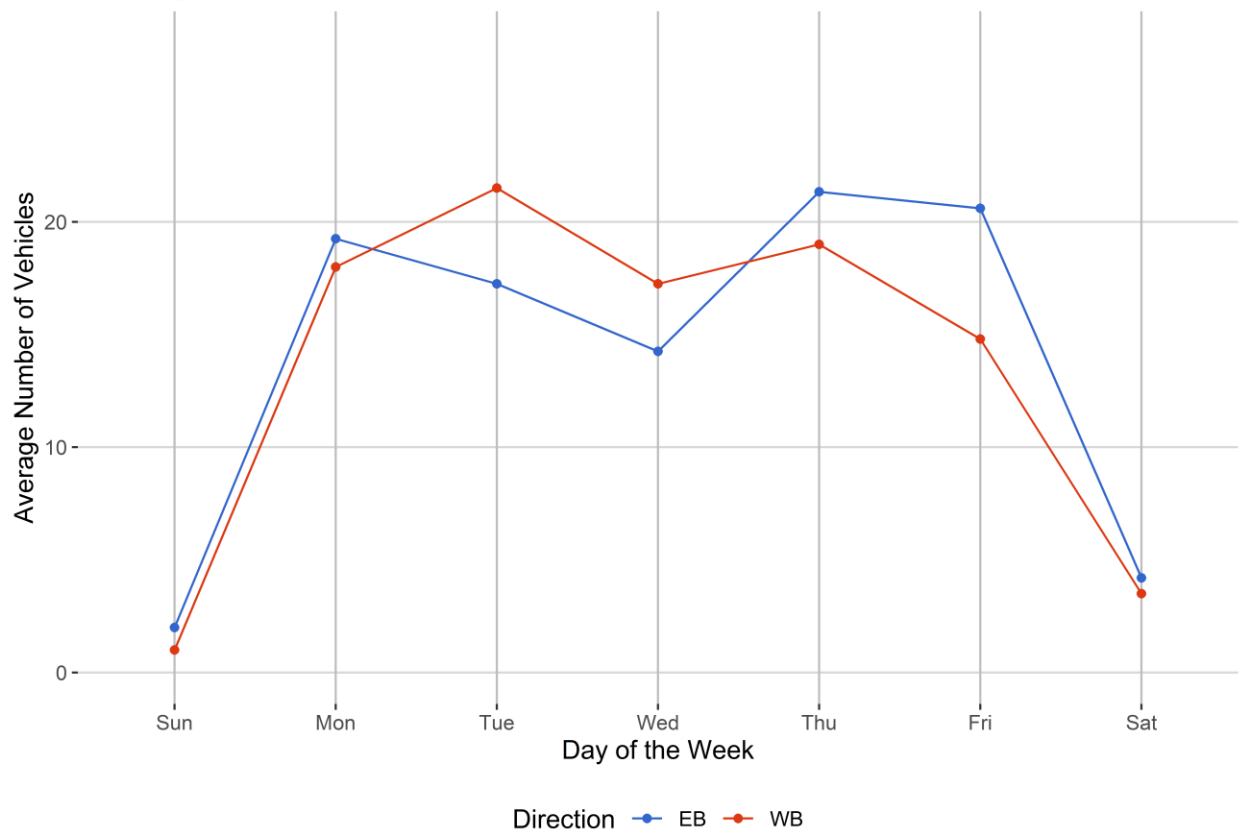


Figure 4 - Passenger Vehicles
vs. Hour of the Day

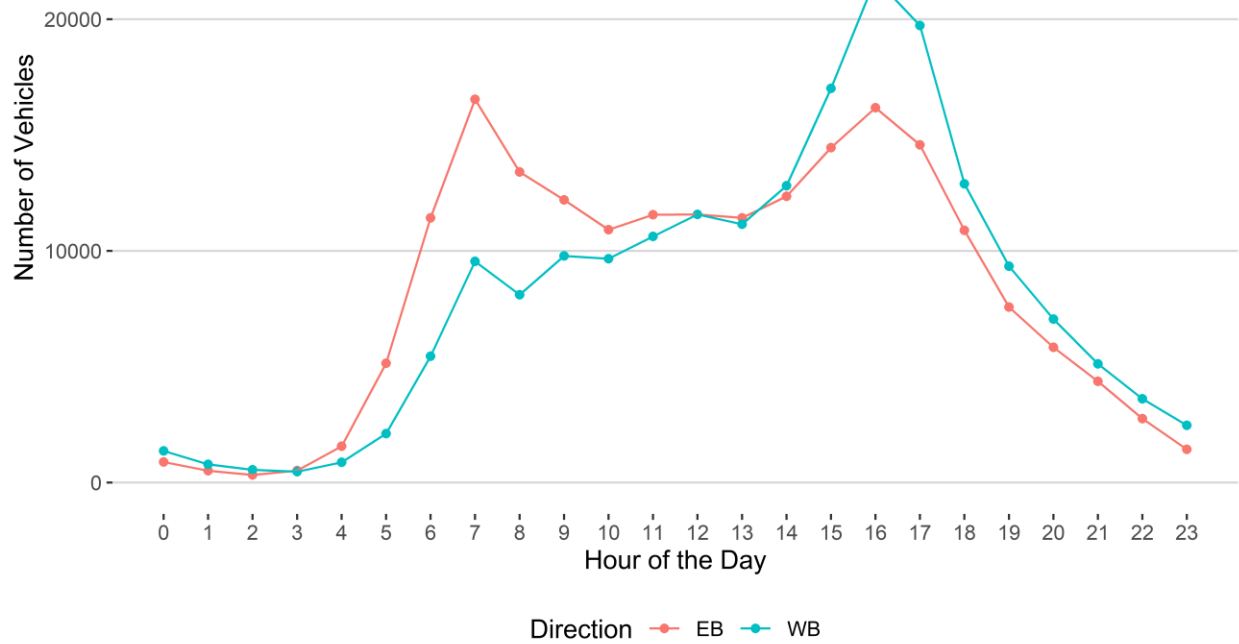


Figure 5 - Heavy Commercial Vehicles
vs. Hour of the Day

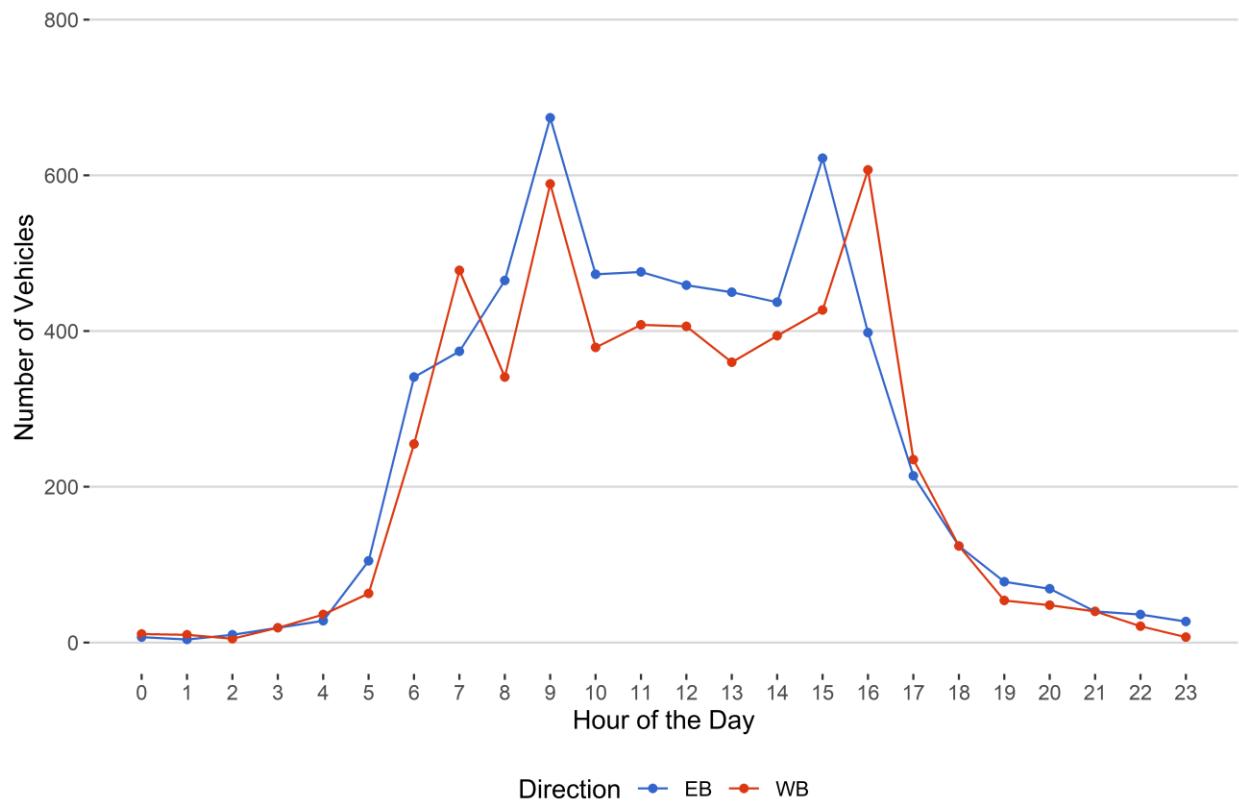


Figure 6 - Overweight Vehicles by Class
vs. Hour of the Day

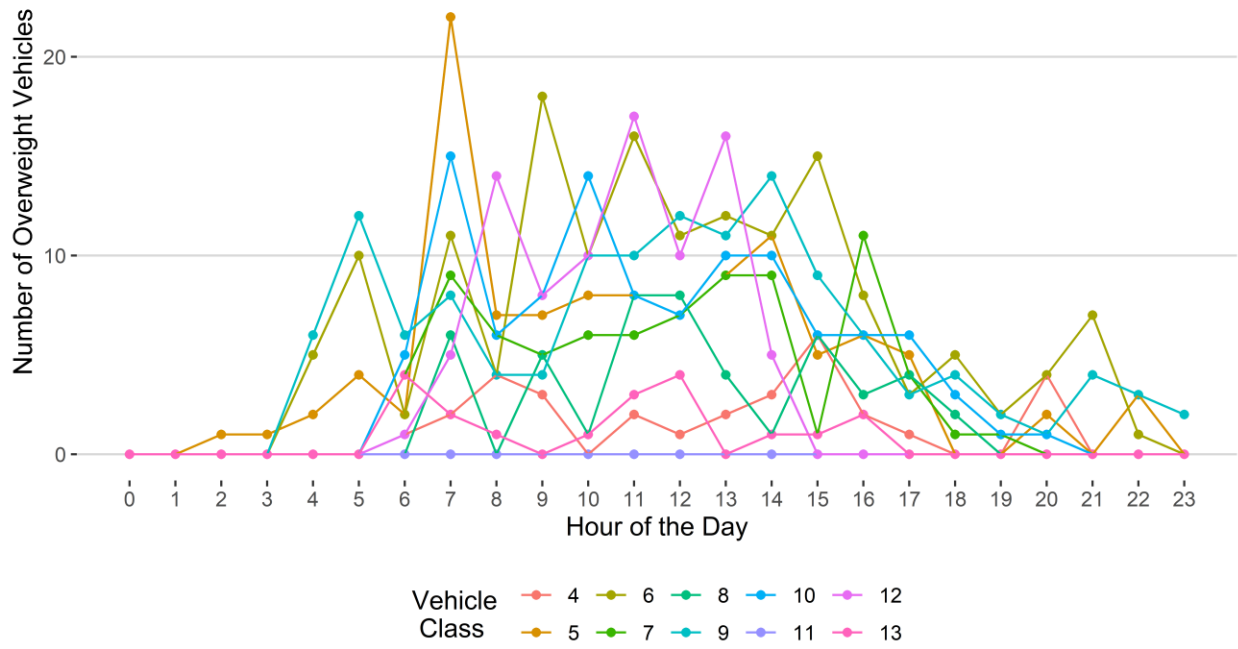


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

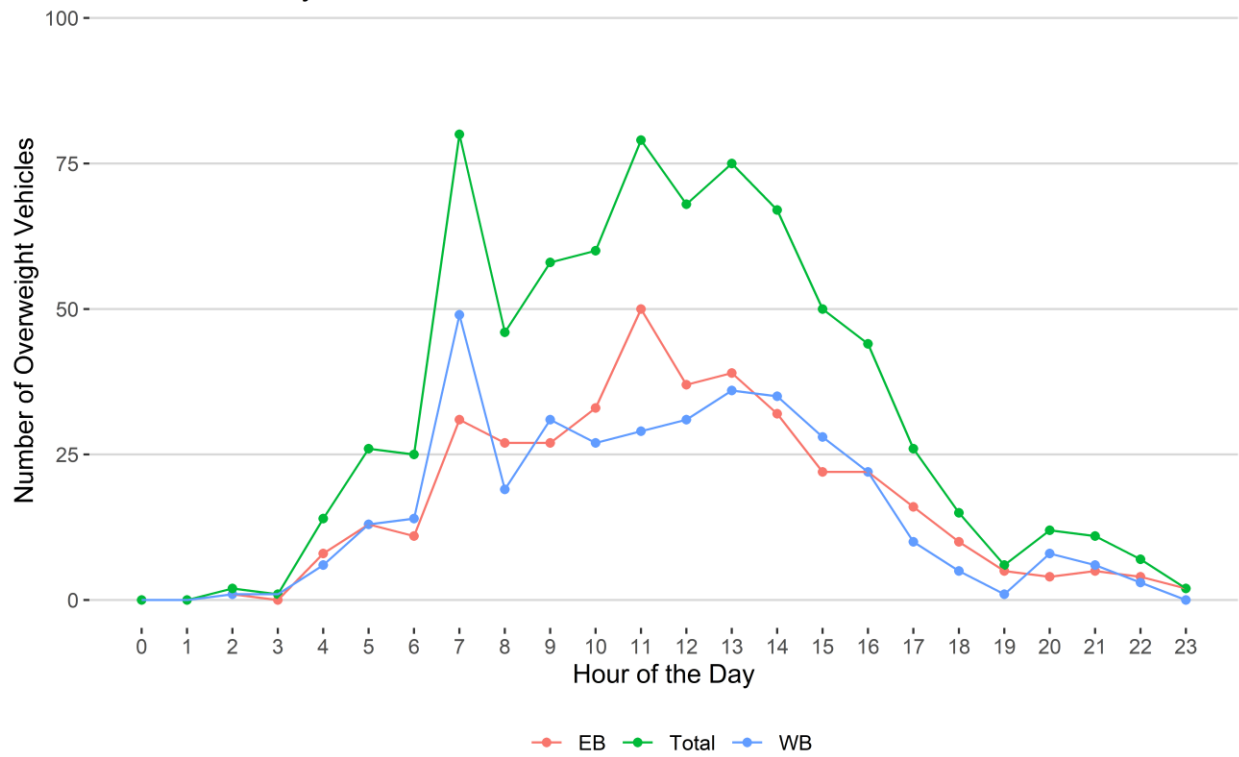
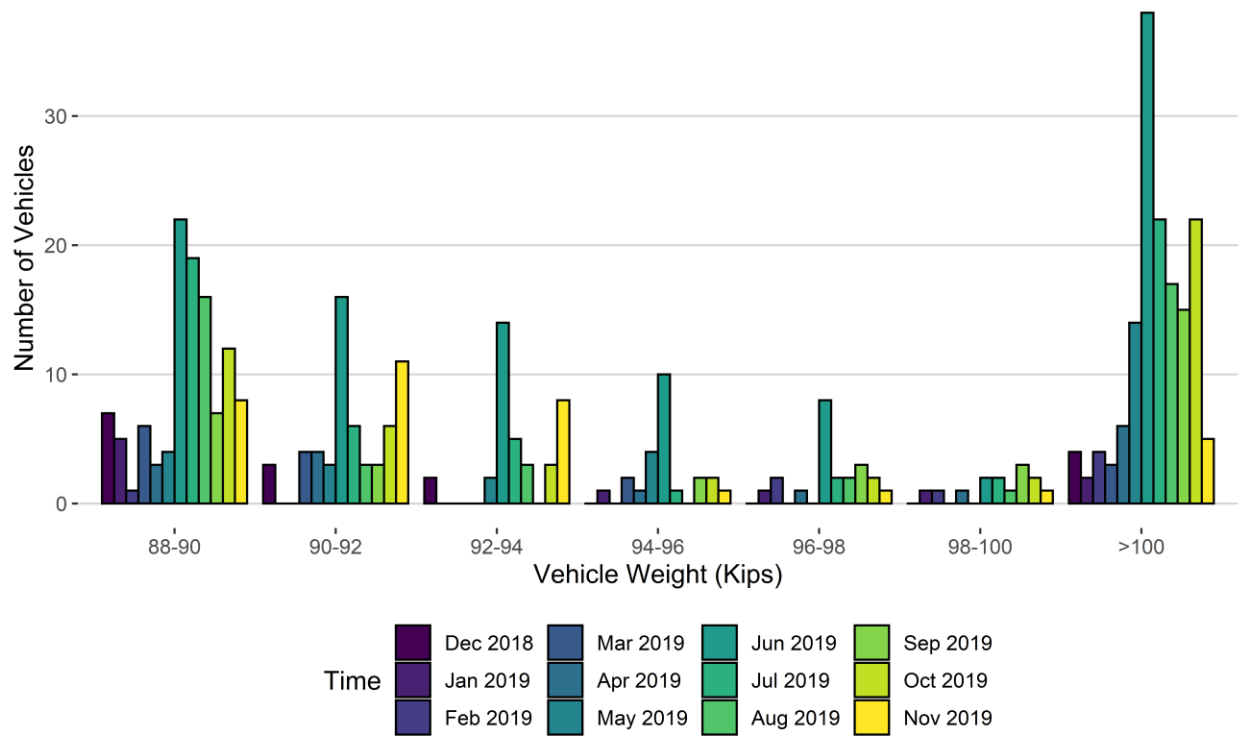
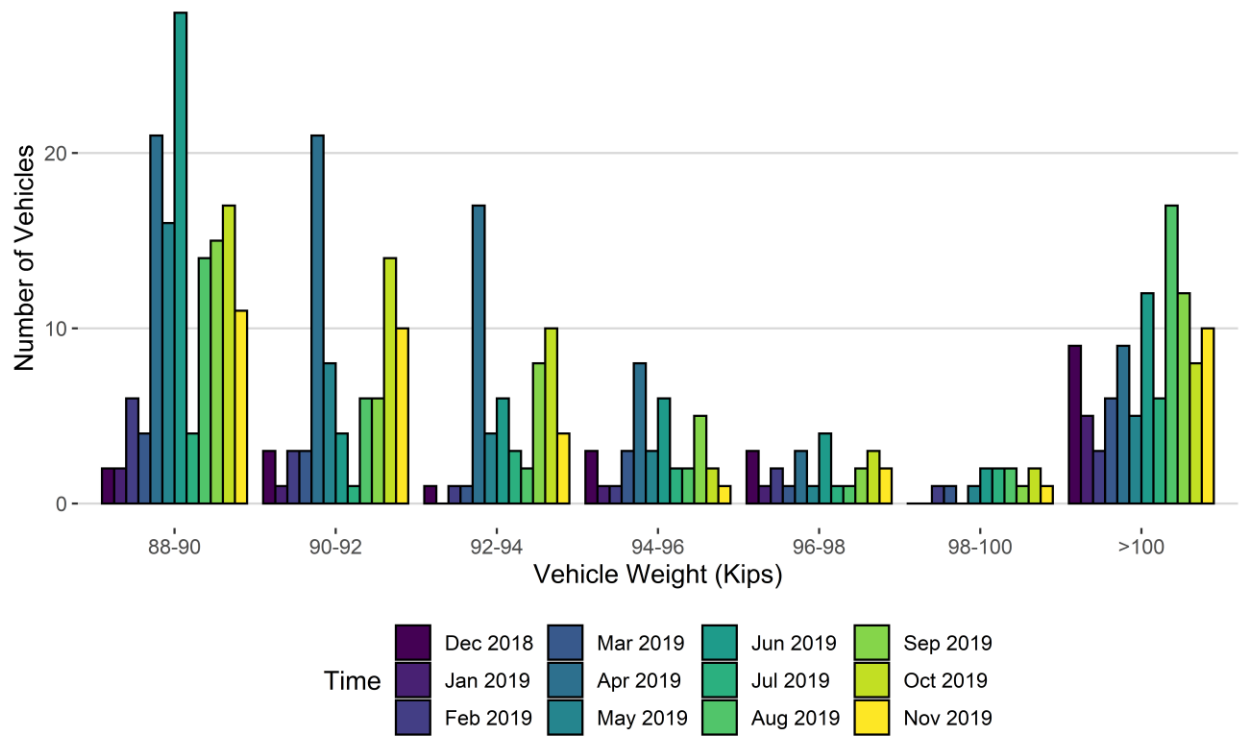


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019
88-90	7	5	1	6	3	4	22	19	16	7	12	8
90-92	3	0	0	4	4	3	16	6	3	3	6	11
92-94	2	0	0	0	0	2	14	5	3	0	3	8
94-96	0	1	0	2	1	4	10	1	0	2	2	1
96-98	0	1	2	0	1	0	8	2	2	3	2	1
98-100	0	1	1	0	1	0	2	2	1	3	2	1
>100	4	2	4	3	6	14	38	22	17	15	22	5
Total	16	10	8	15	16	27	110	57	42	33	49	35

Figure 8 - Histogram of WB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019
88-90	2	2	6	4	21	16	28	4	14	15	17	11
90-92	3	1	3	3	21	8	4	1	6	6	14	10
92-94	1	0	1	1	17	4	6	3	2	8	10	4
94-96	3	1	1	3	8	3	6	2	2	5	2	1
96-98	3	1	2	1	3	1	4	1	1	2	3	2
98-100	0	0	1	1	0	1	2	2	2	1	2	1
>100	9	5	3	6	9	5	12	6	17	12	8	10
Total	21	10	17	19	79	38	62	19	44	49	56	39

Figure 8 - Class 9's and 10's by Direction
vs Gross Vehicle Weight

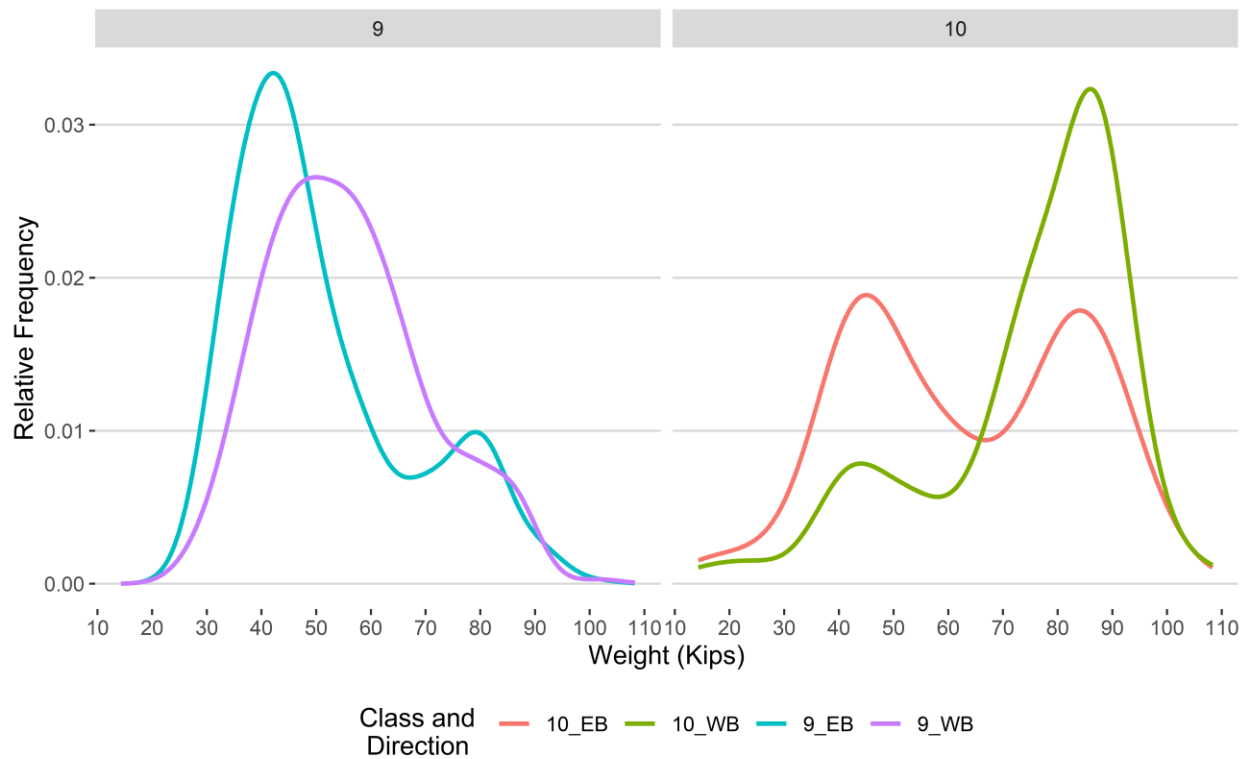


Figure 9 - Freight Percentage
by Direction and Class

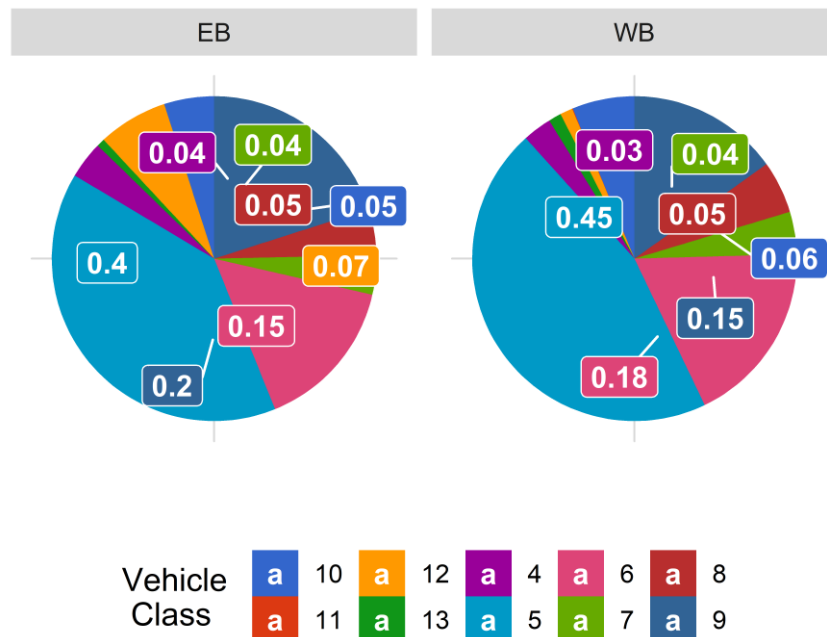


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane



Figure 11 - Total Gross Vehicle Weight t

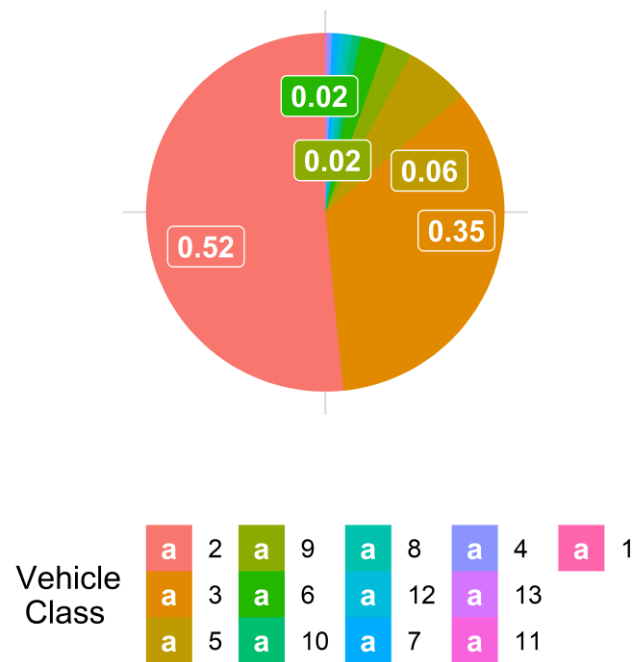


Figure 12 - Total ESALs by Class and Lane

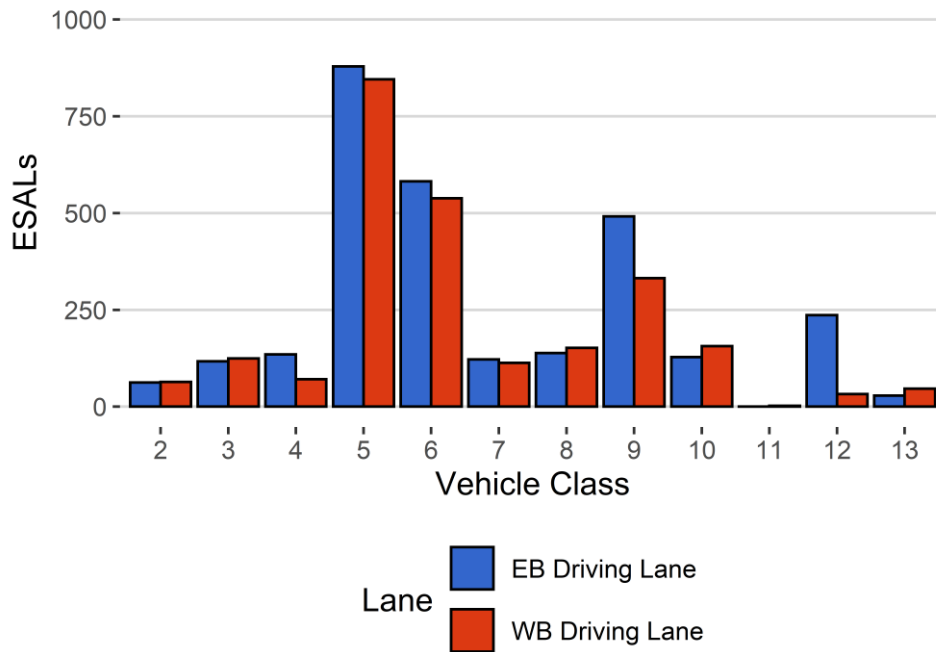


Figure 13 - ESALs by Class

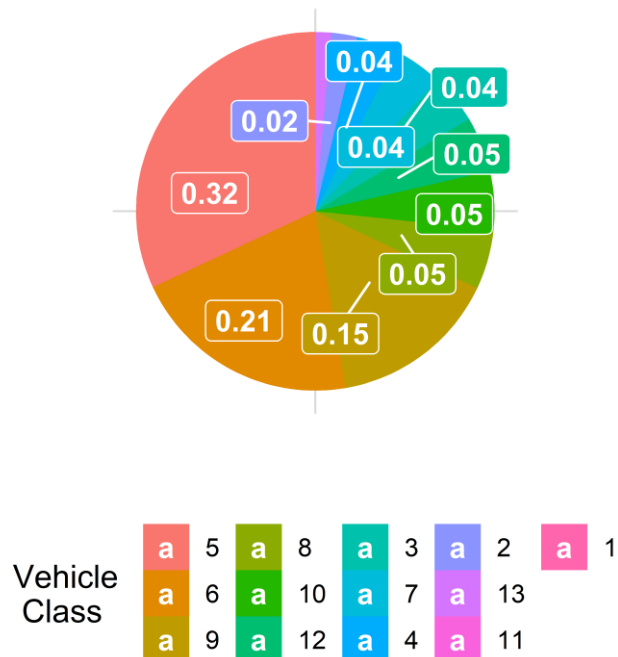


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
February 2016	11.29	0.00	10.54	0.00
March 2016	11.21	-0.66	10.73	1.86
April 2016	11.05	-2.13	10.74	1.89
May 2016	10.75	-4.71	10.19	-3.28
June 2016	10.71	-5.12	10.39	-1.38
July 2016	10.72	-5.02	10.36	-1.66
October 2016	10.68	-5.35	10.58	0.39
November 2016	10.87	-3.64	10.46	-0.76
March 2017	11.18	-0.93	10.67	1.29
April 2017	11.29	0.03	10.39	-1.41
May 2017	10.93	-3.13	10.57	0.31
June 2017	10.82	-4.11	10.61	0.71
July 2017	10.93	-3.18	10.65	1.01
August 2017	10.86	-3.76	10.50	-0.39
September 2017	10.74	-4.84	10.55	0.11
October 2017	10.76	-4.66	10.48	-0.58
November 2017	10.72	-5.00	10.41	-1.23
December 2017	10.53	-6.74	10.36	-1.74
January 2018	11.18	-0.95	10.56	0.22
February 2018	11.38	0.81	10.80	2.44
March 2018	11.50	1.90	10.88	3.23
April 2018	11.05	-2.07	10.90	3.47
May 2018	10.84	-3.96	10.64	0.98
June 2018	10.79	-4.43	10.44	-0.89
July 2018	10.84	-3.91	10.66	1.15
August 2018	10.92	-3.22	10.83	2.74
September 2018	10.90	-3.41	10.91	3.49
October 2018	11.00	-2.54	10.84	2.90
November 2018	10.83	-4.03	10.65	1.04
December 2018	10.97	-2.76	10.86	3.08
January 2019	10.95	-2.96	10.93	3.69
February 2019	11.27	-0.11	10.94	3.80
March 2019	11.33	0.37	11.27	6.95
April 2019	11.06	-1.97	11.26	6.80
May 2019	10.96	-2.85	11.05	4.82
June 2019	11.06	-2.00	10.90	3.46
July 2019	11.05	-2.10	10.84	2.90
August 2019	10.99	-2.62	11.06	4.96
September 2019	11.16	-1.14	11.16	5.87

October 2019	11.07	-1.90	10.99	4.30
November 2019	10.97	-2.76	11.07	4.99

Table 2 Vehicle Classification Data

<i>Vehicle Class</i>	<i>Monthly Average Daily Volume</i>	<i>Monthly Total Volume</i>	<i>Monthly Total Volume Percentage</i>	<i>Monthly Total Overweight Vehicles</i>	<i>Monthly Total Overweight Percentage</i>
1	0	7	0	0	0
2	9102	273065	67	0	0
3	4109	123270	30.2	0	0
4	10	308	0.1	31	4.1
5	257	7718	1.9	110	14.4
6	43	1284	0.3	155	20.3
7	6	185	0	79	10.3
8	15	450	0.1	48	6.3
9	32	970	0.2	131	17.1
10	8	232	0.1	106	13.9
11	0	1	0	0	0
12	6	165	0	86	11.2
13	1	31	0	19	2.5
TOTAL	13590	407686	100	765	100

Table 3 Top 10 Gross Vehicle Weight, Class 9 and 10

<i>Date</i>	<i>Day of Week</i>	<i>Time</i>	<i>Vehicle Class</i>	<i>Direction</i>	<i>Lane</i>	<i>GVW (lbs)</i>
2019-11-26	Tuesday	13:51:22	10	WB	2	108.28
2019-11-19	Tuesday	07:47:41	10	EB	1	102.28
2019-11-04	Monday	14:30:10	9	EB	1	101.9
2019-11-06	Wednesday	14:15:49	9	WB	2	101.85
2019-11-07	Thursday	17:15:00	10	WB	2	101.3
2019-11-13	Wednesday	16:05:06	10	WB	2	100.61
2019-11-22	Friday	13:05:35	10	EB	1	99.6
2019-11-07	Thursday	08:46:59	10	WB	2	98.12
2019-11-04	Monday	17:37:58	10	WB	2	97.92
2019-11-10	Sunday	14:28:36	9	EB	1	96.55

Table 4 Freight Summary

<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	EB	15	180	27	15	5387	353	1546
5	EB	8	3897	338	8.7	59131	2403	15330
6	EB	19	646	9	1.4	23566	152	5732
7	EB	11.5	97	0	0	6053	0	2469
8	EB	31	220	99	45	5351	1758	800
9	EB	33	611	43	7	29820	1299	5538
10	EB	33.5	122	6	4.9	7581	135	1847
12	EB	36.5	143	0	0	10769	0	2775
13	EB	31.5	14	0	0	1258	0	408
TOTAL	****	****	5930	522	****	148917	****	36445
<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	WB	15	125	17	13.6	3491	231	936
5	WB	8	3755	278	7.4	56782	1939	14483
6	WB	19	627	7	1.1	23566	108	5893
7	WB	11.5	86	0	0	5449	0	2230
8	WB	31	226	132	58.4	4179	2585	632
9	WB	33	351	9	2.6	19263	265	3989
10	WB	33.5	108	3	2.8	7979	62	2231
11	WB	36.5	1	0	0	71	0	17
12	WB	36.5	21	0	0	1630	0	432
13	WB	31.5	17	1	5.9	1633	15	565
TOTAL	****	****	5317	447	****	124044	****	31407
GRAND TOTAL	****	****	11247	969	174	272960	11304	67852

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>
1	6	3	9	0
2	544327	524385	1068712	51.6
3	365874	352323	718197	34.7
4	5740	3722	9462	0.5
5	61534	58721	120255	5.8
6	23718	23674	47392	2.3
7	6053	5449	11502	0.6
8	7110	6763	13873	0.7
9	31119	19528	50647	2.4
10	7716	8040	15756	0.8
11	0	71	71	0
12	10769	1630	12399	0.6
13	1258	1648	2906	0.1
TOTAL	1065224	1005959	2071183	100
GVW/LANE	51.43	48.57	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0.125
2	62	64	126	2.3	9e-04
3	117	124	241	4.5	0.004
4	135	71	206	3.8	1.36
5	879	846	1724	31.9	0.46
6	582	538	1120	20.8	1.77
7	122	113	235	4.3	2.53
8	138	152	290	5.4	1.31
9	491	332	823	15.2	1.72
10	128	156	284	5.3	2.43
11	0	2	2	0	1.29
12	236	33	269	5	3.15
13	28	46	75	1.4	3.74
TOTAL	2919	2478	5396	100	20
ESALS/LANE	54.1	45.9	100	-	-

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCADT</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>
Dec 2018	387498	12500	313	377791	97.5	9706.9	2.5
Jan 2019	367731	11862	300	358419	97.5	9311.5	2.5
Feb 2019	343809	12279	328	334638	97.3	9170.8	2.7
Mar 2019	385777	12444	286	376903	97.7	8874.2	2.3
Apr 2019	420217	14007	355	409564	97.5	10653.3	2.5
May 2019	484371	15469	467	469906	97	14465.4	3
Jun 2019	447421	14914	380	436036	97.5	11385.3	2.5
Jul 2019	404321	12901	335	393924	97.4	10396.9	2.6
Aug 2019	416566	13437	356	405520	97.3	11045.9	2.7
Sep 2019	445533	15002	464	431613	96.9	13919.9	3.1
Oct 2019	470635	15082	500	455121	96.7	15513.7	3.3
Nov 2019	407686	13603	378	396342	97.2	11343.9	2.8
TOTAL	4981565	-	-	4845777	-	135788	-
AVERAGE	415130	13625	372	403815	97	11316	3

###ESALs

<i>Month</i>	<i>ESALS EB Driving Lane</i>	<i>ESALS WB Driving Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Dec 2018	2365	2179	4544	1.6
Jan 2019	2057	1877	3933	1.3
Feb 2019	2201	2100	4301	1.1
Mar 2019	2197	1698	3894	2.1
Apr 2019	2374	2514	4888	15.4
May 2019	3494	3224	6717	4.3
Jun 2019	6067	4480	10547	6.4
Jul 2019	3071	1861	4932	4
Aug 2019	2786	2746	5532	3.7
Sep 2019	3726	2987	6713	2.1
Oct 2019	3822	3710	7531	2.9
Nov 2019	2924	2500	5424	4.9
TOTAL	37082	-	-	-
AVERAGE	3090	2656	5746	4

###Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Dec 18	996068	942253	1938320
Jan 19	928842	879765	1808607

Feb 19	893522	831150	1724672
Mar 19	1002496	848116	1850612
Apr 19	1090589	993366	2083955
May 19	1300770	1199019	2499789
Jun 19	2470166	2048533	4518699
Jul 19	1170043	874938	2044980
Aug 19	1057506	1074847	2132353
Sep 19	1190943	1137172	2328115
Oct 19	1254288	1226776	2481064
Nov 19	1065576	1008461	2074037
TOTAL	14420810	13064394	27485205
AVERAGE	1201734	1088700	2290434

###Overweight Vehicles

<i>Month</i>	<i>Total Number of Overweight Vehicles</i>	<i>Overweight / Total Volume</i>	<i>Overweight / Heavy Commercial Volume</i>	<i>Number Over 88,000 lbs</i>	<i>Number Over 98,000 lbs</i>
Dec 2018	693	0.2	7	37	13
Jan 2019	492	0.1	5.2	20	8
Feb 2019	553	0.2	5.9	27	11
Mar 2019	470	0.1	5.1	34	10
Apr 2019	638	0.2	5.8	95	16
May 2019	999	0.2	6.8	66	20
Jun 2019	1566	0.2	6.8	172	54
Jul 2019	761	0.2	7.2	76	32
Aug 2019	939	0.2	8.4	86	37
Sep 2019	974	0.2	6.9	85	32
Oct 2019	1158	0.2	7.4	105	34
Nov 2019	774	0.2	6.7	74	17
TOTAL	10017	-	-	877	284
AVERAGE	834.8	0.2	6.6	73.1	23.7

###Freight

<i>Month</i>	<i>EB Freight Tons</i>	<i>WB Freight Tons</i>	<i>Total Freight</i>	<i>EB Freight %</i>	<i>WB Freight %</i>
Dec 2018	31218	27144	58362	53.5	46.5
Jan 2019	25566	23173	48739	52.5	47.5
Feb 2019	25807	22634	48441	53.3	46.7
Mar 2019	26399	20405	46803	56.4	43.6
Apr 2019	30513	29739	60251	50.6	49.4
May 2019	45606	43096	88702	51.4	48.6

Jun 2019	76795	58724	135519	56.7	43.3
Jul 2019	39281	23158	62440	62.9	37.1
Aug 2019	35223	33847	69070	51	49
Sep 2019	48501	38842	87342	55.5	44.5
Oct 2019	49038	49561	98598	49.7	50.3
Nov 2019	36445	31407	67852	53.7	46.3
TOTAL	470391	401729	872120	-	-
AVERAGE	39199.3	33477.4	72676.7	53.9	46.1